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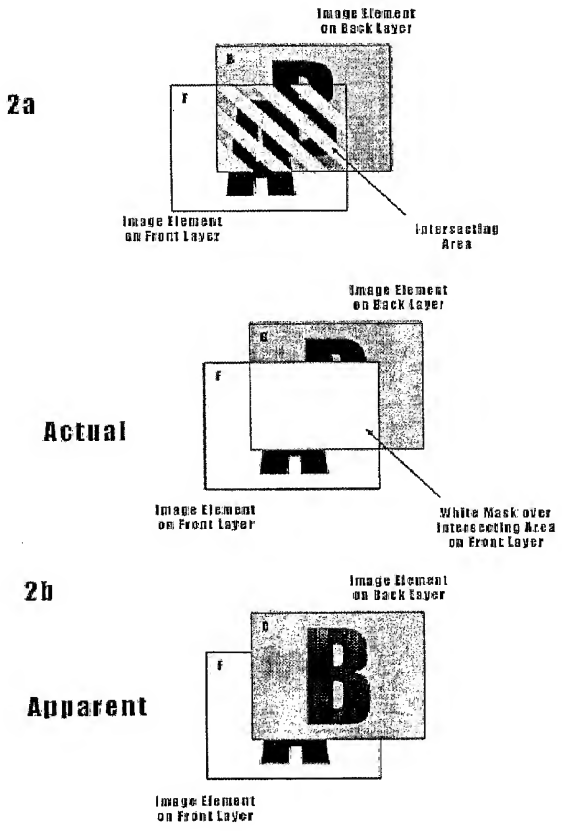
Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

[Continued on next page]

(54) Title: METHOD OF MANIPULATING VISIBILITY OF IMAGES ON A VOLUMETRIC DISPLAY



(57) Abstract: The visibility of an image displayed on a screen of a multi-screen display is manipulated by controlling the transparency or opacity of the image, or of related image elements. For example, the alpha value of the image, or of overlapping image elements on other screens, can be controlled. The visibility can also be enhanced via controlling the characteristics of a mask or a shadow, on the same or a different screen layer as the image.

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— *of inventorship (Rule 4.17(iv))*

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

METHOD OF MANIPULATING VISIBILITY OF IMAGES ON A VOLUMETRIC DISPLAY

FIELD OF THE INVENTION

The invention relates to a method of manipulating the visibility of image elements on the screens of a multi-screen display.

BACKGROUND

Multi-screen displays including two or more screens in a stacked arrangement are known. An example of such a screen is disclosed in PCT/NZ98/00098. Multi-screen displays are capable of displaying image elements on multiple screens at the same time.

In practice, most multi-screen displays are dual screen displays having a front and rear screen in a stacked arrangement. At least a part of front screen must be capable of being made transparent so that images on the rear screen can be seen through it. In addition, at least a part of the front screen should be capable of becoming opaque, so that images on the rear screen could not be seen through it.

In this latter case, the inherent transparency of an LCD screen is problematic. LCD screens cannot be made to be 100% opaque. Accordingly, there will be leakage of images displayed on the rear screen through the front screen. Where image elements are displayed on more than one screen they may overlap and interfere with each other. This can be distracting.

Each pixel in an LCD screen stores values for colour and an additional value between 0 and 1 (*alpha value*). The alpha value determines how opaque or transparent the image element is in relation to other image elements that are displayed over the same pixels. For example, 40% alpha value for an image element will mean that it is 60% transparent (or 40% opaque).

All references, including any patents or patent applications cited in this specification are hereby incorporated by reference. No admission is made that any reference constitutes prior art. The discussion of the references states what their authors assert and the applicant reserve the right to challenge the

accuracy and relevance of the cited documents. It will be clearly understood that, although a number of prior art publications are referred to herein; the reference does not constitute an admission that any of these documents form part of the common general knowledge in the art, in New Zealand or in any other country.

It is acknowledged that the terms 'comprise', 'comprises' and 'comprising' may, under varying jurisdictions, be attributed with either an exclusive or inclusive meaning. For the purpose of this specification, and unless otherwise noted, the terms 'comprise', 'comprises' and 'comprising' shall have an inclusive meaning – i.e. they will be taken to mean an inclusion of not only the listed components it directly references, but also other non-specified components or elements.

OBJECT OF THE INVENTION

It is an object of the present invention to provide a method to manipulate the visibility of image elements on the screens of a multi-screen display, or to at least provide a useful choice.

STATEMENT OF INVENTION

In one aspect the invention relates to a method of manipulating the visibility of a target image element displayed on a screen of a multi-screen display including the steps:

a) Selecting at least one target image element;

b) Identifying the screen on which the target image element is displayed and the position of the target image element on the screen;

c) Manipulating the transparency of the target image element to the desired level, using one or more of the following:

   a. Manipulating the characteristics of the target element image to adjust its transparency;

b. Identifying partially overlapping image elements in substantially the same position on a different screen to the target image element and manipulating the characteristics of the overlapping image elements to adjust the transparency of the target image element;

c. Placing a supporting image element in substantially the same position on the same or different a screen from the target image element.

Preferably the characteristics of the image elements to be manipulated are selected from, but not limited to, alpha values; colour; hue; saturation; brightness; or RGB values.

Preferably the supporting image element is a shadow or a mask.

Preferably the selection of the target image element may be conducted by a user or a software programme.

Preferably where the target image element is displayed on the front screen, its visibility may be increased by:

a) Increasing the alpha value of the target image element;

b) Decreasing the alpha value of any overlapping image elements;

c) Introducing, or increasing the alpha value of, a shadow on a screen behind the target image element;

d) Decreasing the alpha value of any mask overlapping the target image element on the front screen; or

e) Any combination of a) to d).

Preferably where the target image element is to be displayed on the rear screen, its visibility may be increased by:

a) Increasing the alpha value of the target image element;

b) Decreasing the alpha value of any overlapping image element;

c) Introducing or increasing the alpha value of a mask on a screen in front of the rear screen;

d) Decreasing the alpha value of any shadow overlapping the target image element on the rear screen; or

e) Any combination of a) to d).

These techniques may be used for one or more image elements depending on the effect desired.

The method may affect all image elements on a screen or it may be limited to selected image elements or parts thereof.

Many methods of selecting image elements are known. These are useable in this invention.

Preferably the methods described above will be incorporated into an electronic form such as a software programme.

In this specification the following terms have the meanings set out below:

Image Element: Any visual item generated for a display. By way of example, this may comprise a series of windows, a single window or other components whether or not they are within a window.

Shadow: An image element positioned substantially behind a target image element on a multi-screen display screen. The shadow is formed from a solid colour which affects the visibility of the image element positioned on a screen in front of that image element. In the case of an LCD the preferred colour for the shadow is white. Other screen technologies or effects may require different colours.

Mask: An image element positioned substantially in front of a target image element on a multi-screen display screen. The mask is formed from a solid colour which affects the visibility of a target image element and is positioned on a screen in front of the target image element. In the case of an LCD the preferred colour for the mask is white. The white portions of an LCD are transparent. Accordingly, where the front screen of the multi-screen display is an LCD the mask is formed by colouring the masking image element white. Other screen technologies or effects may require different colours or techniques to achieve the requisite transparency.

Alpha Value: An image element stores information for each pixel that is involved in the final display. Each pixel stores values for colour and an additional value between 0 and 1. This value is the *alpha value*. The alpha value determines how opaque or transparent the image element is in relation to other image elements that are displayed over the same pixels. For example, 40% alpha value for an image element will mean that it is 60% transparent.

Actual Transparency: The transparency of an image element within a single screen is determined solely by the alpha value.

Apparent Transparency: The transparency of an image element perceived from a multi-screen display user's point of view. This is a cumulative effect resulting from by way of example, the Actual Transparency, masking and shadowing effects used on the individual screens of multi-screen displays.

Multi-Screen Display: a display having at least two screens in a stacked arrangement.

Screen(s): a physical display layer of a display device, such as an LCD panel.

In the following description reference is made to a dual screen display where both screens are LCDs. The methods of the invention are applicable to any multi-screen display where the front screen or screens are capable of becoming at least partially transparent. Suitable technologies for use as the front screen

of a multi-screen display include, by way of example, LCDs, TOLEDs or monochrome plasma screens.

In the following description, reference is made to white masking. Displaying white on a LCD renders the "white" portion of the display transparent. Where the front screens are not LCD a different mechanism, eg a different colour, may be required to achieve transparency. This mechanism may be used in place of the white masking to effect the method of the present invention.

Further aspects of the present invention will become apparent from the following description which is given by way of example only and with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 Shows the transition between two extreme states where the viewer can see an object in the front screen at varying levels of apparent transparency.

Figure 2 Shows the ability to cut through masking objects in the front screen to completely show an object in the back screen

DETAILED DESCRIPTION

The invention will be described with reference to a dual screen display having two LCD panels in a stacked arrangement. As will be appreciated by those skilled in the art the invention is readily adaptable to displays having more than two screens.

Figure 1 shows the transition between two extremes. In the first state, shown in Figure 1a, a target image element is displayed on the front screen. The corresponding area on the rear screen is shadowed in white. This gives the target image element an opaque appearance. In the other extreme state (shown in Figure 1f) the alpha value of the white shadow is reduced to zero and the target image element appear less visible.

The transition between these two states has two main phases:

1. Shadow Fade Out: The alpha value of the white shadow on the rear screen decreases. The other image elements on the rear screen that share the same pixels as the white shadow become more visible.

2. Mask Fade In: A white mask is placed over the image element in the front screen. The alpha value of the white shadow is gradually increased from 0% to 100%. As this happens, other image elements in the front screen that share the same pixels as the white mask become less visible.

The shadow on the rear screen is made more transparent by decreasing its alpha value. As the alpha value tends to zero the shadow becomes more transparent. As the shadow is made more transparent, the image on the back screen becomes more visible. This has the effect of making it appear that the element on the front screen is becoming more transparent. In fact the alpha value of the element on the front screen is constant.

In some circumstances, increasing the visibility of image elements on the rear screen may have the effect of increasing the apparent transparency of an overlapping target image on the front screen.

Where the alpha value of the image element on the front screen is decreased the selected image element on the front screen becomes more transparent. If there are multiple overlapping image elements on the front screen, decreasing the alpha value of the selected image element will increase the visibility of the other image elements on the front screen. If the other image elements are predominantly white or there are no other image elements then the image element displayed on the rear screen may become more visible.

An alternative way of achieving this effect is to place a white mask over the image element on the front screen. White on the front screen is transparent. So, as the alpha value of the white mask increases to 100%, the apparent

transparency of the mask would increase. This would enable the image on the rear screen to be clearly visible through the front screen.

The stages transiting the shift from the opaque front screen to a complete apparent transparency are shown in Figure 1. In this case the alpha value of the white shadow on the rear screen is decreased and then a mask is placed in front of the image element on the front screen. The alpha value of this mask can be increased to increase apparent transparency. This renders the masked portion of the front screen transparent making the image element on the rear screen easily viewable. This is indicative of one embodiment of the method however the invention is not limited simply to this.

In addition, it will be appreciated that the process can be reversed to render an image element on the front screen visible in preference to an image element on the rear screen.

In Figure 1a, an image element is displayed on the front screen of a dual screen display. The image element has a high alpha value, for example 100%. On the rear screen is a white shadow corresponding with the image element. The white shadow also has a high alpha value of, for example 100%.

The effect of this combination is that the image element on the front screen appears to be completely opaque. No image is visible through the image element.

In Figure 1b the alpha value of the white shadow decreases, for example to 50%. As this occurs the image element behind the white shadow on the rear screen becomes more visible. The alpha value of the image element on the front screen remains unchanged. That is its actual transparency remains unchanged.

The combined effect of these actions is that the image element on the front screen appears to be partially transparent. In fact, its actual transparency is unchanged.

In Figure 1c the alpha value of the white shadow is decreased to 0%. The image element behind the white shadow on the rear screen is completely displayed on that screen. The alpha value of the image element on the front screen remains unchanged. That is its actual transparency remains unchanged.

The effect of this combination however, is that the image element appears even more transparent. In fact its actual transparency is unchanged.

In Figure 1d, a white mask is placed in front of the image element on the front screen. The white mask has an alpha value of 0%. Accordingly it has no effect on the appearance.

In Figure 1e, the alpha value of the white mask is increased to 50%. The alpha value of the image element is unchanged. However the white mask renders the screen partially transparent. The alpha value of the white shadowing on the rear screen remains at 0%.

The effect of this combination is that the image element appears to be more transparent. So the image element on the rear screen is more easily viewed.

In Figure 1f, the alpha value of the white mask is 100%. Again the alpha value of the image element is unchanged. The image element is completely hidden from view by the effect of the white mask.

The effect is that the portion of the front screen including the image element is completely transparent. The image element on the rear screen is easily viewed through the front screen.

As will be appreciated, for clarity the transit has been described with the increasing transparency of the shadow and the image element on the front screen occurring as separate and discrete events. This need not be the case. It is possible the alpha value of the image element on the front screen may be decreased before or while the alpha value of the white shadow is decreasing.

Similarly the inclusion of the white mask in front of that image element may begin while the alpha value of the white shadow is decreasing.

Manipulating the relative transparency of image elements on the front and rear screens will enable a user to select which image elements on each screen are clearly visible. Different image elements can be selected and made visible with ease. This is particularly advantageous where comparisons are being made between different documents or image elements.

The software is set up so that selection and changes in transparency are preferably manipulated by user input, for example keystrokes or mouse movements. In the preferred embodiment these are configurable by the user. It is envisioned that these may be automated to a greater or lesser extent by the use of a software programme.

Another way to achieve visibility of target image elements is to make any overlapping image element transparent.

This method is outlined in Figure 2. The method is directed to situations where the selected image element is located on the rear screen and involves:

a) Detecting the position of the selected image element;

b) Determining whether there is an image element on the front screen which is in a corresponding position with the position of the selected image element;

c) Identifying any intersecting area; and

d) Placing a white mask over the intersecting area on the front screen transparent.

The intersecting area can be made transparent by placing a white mask over it. The use of white on the front screen of a multi-screen display has the effect of rendering the 'white' portion transparent. By placing a white mask over the

intersecting area the image element displayed on the rear screen becomes visible. This is clearly seen in Figure 2b.

As can be seen on Figure 2 the effect is to display the selected image element in preference to other intersecting image elements.

Where the background on the front screen is white, transparency may be achieved by changing the alpha value of any overlapping image element to zero. In this case the overlapping image element will become transparent. The white background will then dominate. As white on the front screen of a multi-screen display is transparent, the selected image element on the rear screen will be visible through the front screen.

For clarity, this description has referred to single target image elements. However, multiple target image elements may be selected and manipulated using the techniques of the invention.

Aspects of the present invention have been described by way of example only and it should be appreciated that modifications and additions may be made thereto without departing from the scope thereof.

CLAIMS

1. A method of manipulating the visibility of a target image element displayed on a screen of a multi-screen display including the steps:

    a. Selecting at least one target image element;

    b. Identifying the screen on which the target image element is displayed and the position of the target image element on the screen;

    c. Manipulating the transparency of the target image element to the desired level, using one or more of the following:

        i. Manipulating the characteristics of the target element image to adjust its transparency;

        ii. Identifying partially overlapping image elements in substantially the same position on a different screen to the target image element and manipulating the characteristics of the overlapping image elements to adjust the transparency of the target image element;

        iii. Placing a supporting image element in substantially the same position on the same or different a screen from the target image element.

2. A method according to claim 1, wherein the characteristics of the image elements to be manipulated are selected from, but not limited to, alpha values; colour; hue; saturation; brightness; or RGB values.

3. A method according to claim 1 or claim 2, wherein supporting image element is a shadow or a mask.

4. A method according to any one of claims 1 to 3, wherein the visibility of a target image element displayed on the front screen of a multi-screen display is increased by :

a. Increasing the alpha value of the target image element;

b. Decreasing the alpha value of any other overlapping image elements;

c. Introducing, or increasing the alpha value of, a shadow on a screen behind the target image element;

d. Decreasing the alpha value of any mask overlapping the target image element on the front screen; or

e. Any combination of a) to d).

5. A method according to any one of claims 1 to 3, wherein the visibility of a target image element displayed on the rear screen of a multi-screen display is increased by :

a. Increasing the alpha value of the target image element;

b. Decreasing the alpha value of any overlapping image element;

c. Introducing or increasing the alpha value of a mask on a screen in front of the rear screen;

d. Decreasing the alpha value of any shadow overlapping the target image element on the rear screen; or

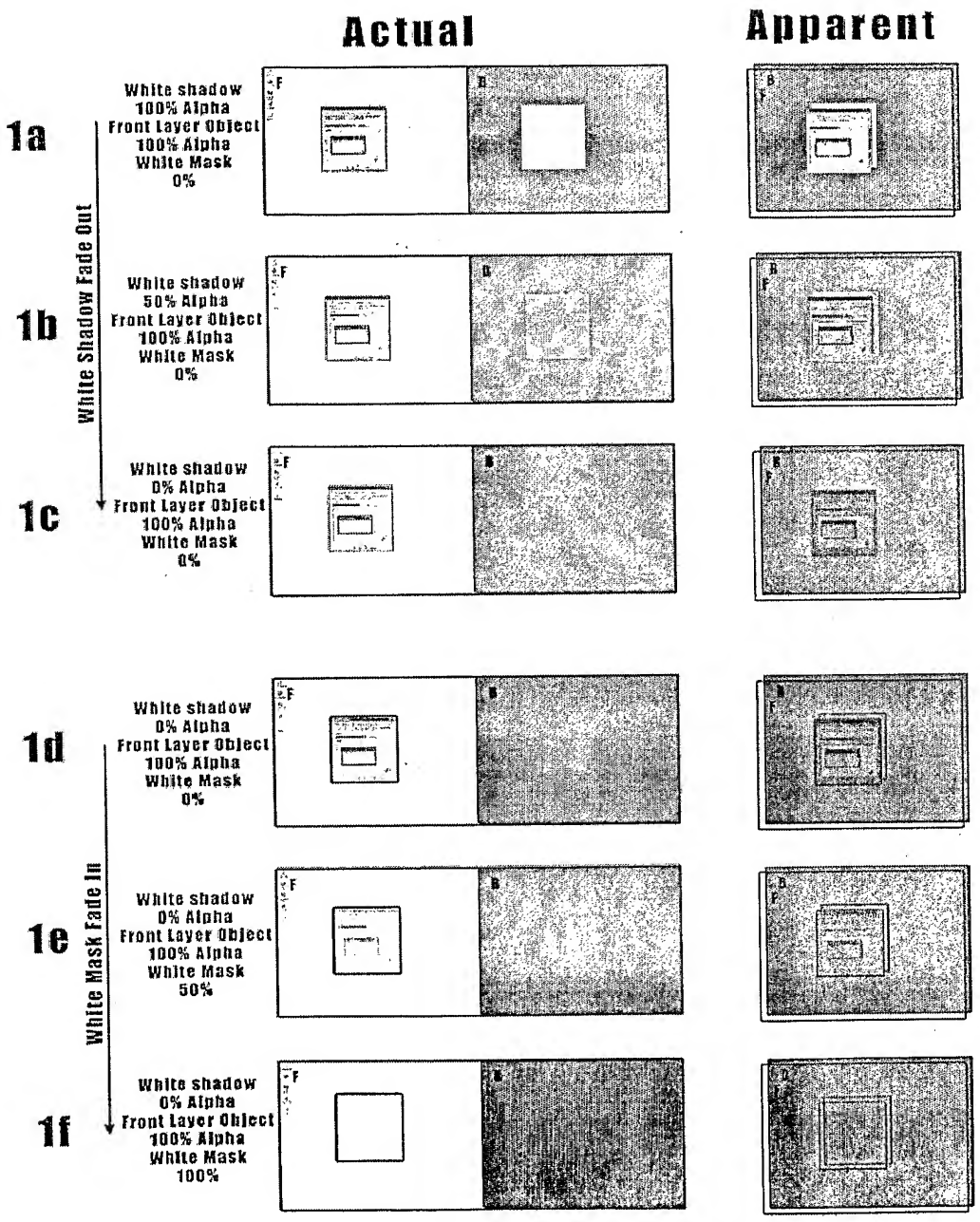
e. Any combination of a) to d).

6. A method according to any one of the previous claims wherein all image elements on a screen are selected as target image elements are limited to selected image elements or parts thereof.

7. A method according to any one of the previous claims wherein the selection of a target image element may be conducted by a user or by a software programme.

8. A method according to any one of the previous claims that is conducted by a user or by a software programme.

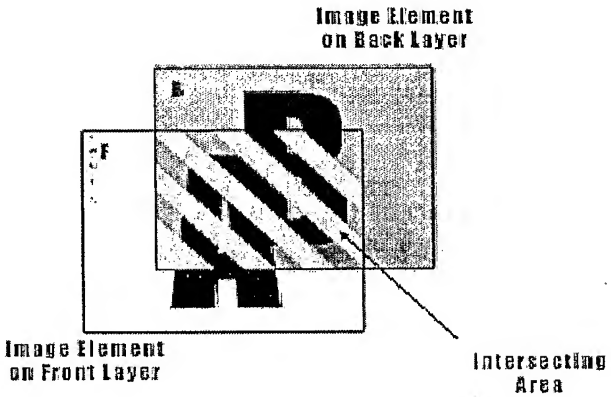
Figure 1


Actual
Apparent
1a
White shadow
100% Alpha
Front Layer Object
100% Alpha
White Mask
0%
White Shadow Fade Out
1b
White shadow
50% Alpha
Front Layer Object
100% Alpha
White Mask
0%
1c
White shadow
0% Alpha
Front Layer Object
100% Alpha
White Mask
0%
1d
White shadow
0% Alpha
Front Layer Object
100% Alpha
White Mask
0%
White Mask Fade In
1e
White shadow
0% Alpha
Front Layer Object
100% Alpha
White Mask
50%
1f
White shadow
0% Alpha
Front Layer Object
100% Alpha
White Mask
100%

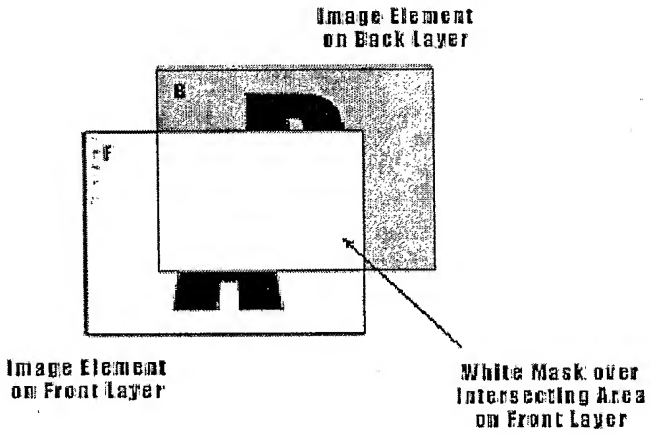
2/2

Figure 2

2a

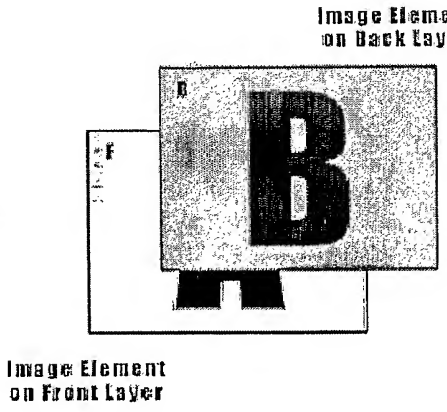


Actual



2b

Apparent



INTERNATIONAL SEARCH REPORT

International application No.
PCT/NZ2006/000258

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

G02F 1/1347 (2006.01) ***G09G 5/00*** (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DWPI Keywords: screen, display; opacit, opaque, transparen, translucen, alpha; layers, layered, stack, dual, overl, plural, multi, sandwich, volumetric, G02F 1/1347; contrast, visibilit, shadow, mask, image, picture; control, manipulat, adjust, chang, var, select; alpha value

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5745197 A (LEUNG et al.) 28 April 1998 Columns 6-10, Figures 1-2	1, 2, 6-8
X	US 3967881 A (MORIYAMA et al.) 6 July 1976 Columns 4-6, Figures 2, 5, 6	1-3, 6-8
X	US 6906762 B1 (WITEHIRA et al.) 14 June 2005 Abstract, columns 4-5	1, 2, 4-8

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 November 2006	06 DEC 2006
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized officer **MICHAEL HALL** Telephone No : (02) 6283 2474

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NZ2006/000258

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2002/0126396 A1 (DOLGOFF) 12 September 2002 Abstract, paragraphs 189, 495	1-3, 6-8
X	EP 605945 A1 (FIRSTPERSON, INC.) 13 July 1994 Abstract	1, 2, 4-8
X	US 6369830 B1 (BRUNNER et al.) 9 April 2002 Column 2	1, 2, 4-8
X	Patent Abstracts of Japan, JP 11-272846 A (MITSUBISHI ELECTRIC CORP) 8 October 1999 Abstract	1, 2, 4-8
X	US 6940507 B2 (REPIN et al.) 6 September 2005 Abstract	1, 2, 4-8
X	US 5515484 A (SFARTI et al.) 7 May 1996 Abstract	1, 2, 4-8

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/NZ2006/000258

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	5745197	NONE					
US	3967881	GB	1470475	JP	50131795	JP	50147890
US	6906762	AU	25542/99	AU	82482/98	CA	2320694
		CA	2329702	CN	1294695	CN	1302389
		EP	1057070	EP	1058862	IL	137628
		JP	2002271819	MX	PA00007981	NZ	505800
		NZ	505801	WO	9942889	WO	9944095
US	2002126396	AU	42317/97	ID	19315	US	6310733
		US	7016116	WO	9810584	ZA	9707351
EP	0605945	JP	6301505	US	5651107	US	5999191
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US	6369830	EP	1177527	US	7106275	US	2002093516
		WO	0068887				
JP	11272846	NONE					
US	6940507	AU	36628/02	CA	2432090	GB	2386811
		NO	20023903	US	2002109684	WO	0250779
US	5515484	NONE					

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX